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(54) **Method and system for acquiring full spine and full leg images using flat panel digital radiography**

(57) Apparatus for acquiring an elongated radiographic image comprising: a flat panel electronic detector of radiographic images, said detector having a known length; and a transport mechanism for mounting said detector for movement in a direction parallel to said known length so that said detector can be positioned in sequential contiguous positions to acquire a radiation image greater in length than said detector length.

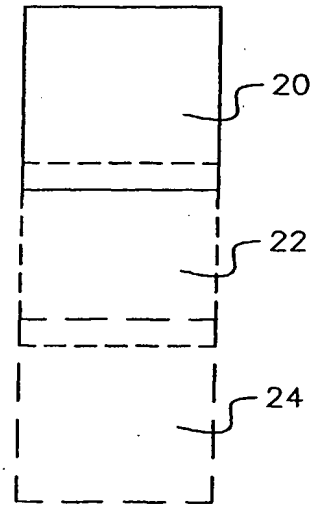

FIG. 2

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Description

[0001] This invention relates in general to digital radiographic imaging, and in particular to the acquisition of multiple, standard sized radiographs for purposes of constructing a larger composite radiographic image.

[0002] Full spine and full leg radiographic examinations require images that are longer than the length of normal-sized radiographic films. The problem is circumvented by two approaches. The first approach uses an extra long, non-standard film. This approach is expensive and inconvenient. The second approach uses several normal-size films for exposure and then tape the sub-images together (see US Patents 3,725,703 and 3,774,703). Computed Radiography (CR) has the same problem. The problem is circumvented by either using an elongated CR plate (US Patent 5,130,542) or by using several CR plates for imaging, and then using digital image processing to stitch the sub-images together (US Patent 5,111,045, 5,986,279 and EPO 9194856A1).

[0003] With the advent of flat panel digital radiography (DR), it is natural to apply the technology to full spine/leg imaging. Various patents teach the assembly of smaller sensor arrays to form a large sensor (US Patents 5,105,087, 4,467,342, and 4,755,686). However, DR sensors are expensive. Thus the DR assembly approach is economically prohibitive. One patent teaches the use of a moving sensor to detect fan beam X-ray in CT scan (US Patent 4,873,708). The approach takes the scanned signals and constructs a sliced image of the body. US Patents 4,613,983 and 5,123,056 disclosure systems for imaging a human subject on a table including an X-ray source, a table and an image intensifier tube. Either the table or X-ray source and table are moved to produce a series of overlapping electronic images which are combined into an elongated image for display or printing. Another patent teaches a moveable X-ray cassette holder design.

[0004] The field of DR is expanding rapidly. Physicians order full spine and full leg imaging routinely for scoliosis patients and for leg length, angulation and deformity measurements. It is therefore necessary to provide an economically feasible capability for acquiring images using flat panel digital radiography that can be used for subsequent construction of full spine and long bone images.

[0005] According to one feature of the invention, it focuses on the sequential acquisition of multiple radiographic images using a moveable DR plate for purposes of digitally constructing a composite larger spine or long bone image.

[0006] According to another feature of the present invention, a standard DR plate is mounted on a moving plate holder. Two or more radiographic images are acquired sequentially. The spatial position of each subsequent image is acquired with a small amount of overlap of the spatial position of the previous image to aid in the construction of the composite image.

[0007] Individual images are acquired in the presence of a reference grid or some other fiducial markers to aid in performing geometric corrections for distortion introduced by the image acquisition process as the DR plate is moved.

[0008] The invention has the following advantages.

1. Composing sub-images acquired by DR is useful for full spine and full leg radiographic examinations. This approach combines the convenience of DR with the flexibility of digital image processing.
2. Only one DR plate is used for image acquisition. The first sub-image can be processed while the second one is being taken. Both cost saving and the convenience of DR imaging can be achieved.

Figs. 1A and 1B are diagrammatic side and front views of a DR plate mounted on a transport mechanism that allows the plate to be repositioned for sequential image capture.

Fig. 2 is a diagrammatic view showing an example of 3 sequentially acquired DR images with a small amount of overlap between each sequential pair.

Fig. 3 is a diagrammatic view showing an example of a fiducial marker, in this example the drawing represents a fine wire grid that has precisely defined squares. The image of the patient is acquired together with the grid, or some other form of reference marker target to facilitate construction of the composite image.

Fig. 4 is a diagrammatic view of a radiographic imaging system incorporating the present invention.

[0009] The present invention enables the sequential acquisition of multiple flat panel digital radiographs using a standard sized flat panel detector in such a way as to facilitate the subsequent construction of a larger composite image. As shown in Fig. 1, the flat panel detector 10 is mounted to a transport mechanism 12 that enables the detector to be moved in the vertical (up or down) direction 14 between each image acquisition. Mechanism 12 is mounted on a frame 16. Detector 10 can be moved manually or be motor driven (not shown). The images are acquired such that there is a small amount of overlap between the previous and next acquisition. Fig. 2 shows the acquisition of 3 overlapped images 20, 22, 24. Fiducial markers are superimposed on the image of the patient so that the distortion introduced by the change in position of the detector relative to the direction of the primary radiation for sequential acquisitions can be corrected. Fig. 3 shows an elongated guide 30 of radiation opaque material, such as lead. As shown in Fig. 4, grid 30 is placed in front of DR plate 10.

[0010] Referring now to Fig. 4, there is shown a radiographic imaging system 40 incorporating the present invention. As shown, system 40 includes a source 42 of penetrating radiation, such as X-rays 41. A patient 44 is

placed between source 42 and detector 10. Detector 10 is mounted for movement in the vertical direction 14 on transport assembly 12 on frame 16. Radiation attenuating grid 30 is positioned between detector 10 and patient 44.

Claims

1. Apparatus for acquiring an elongated radiographic image comprising:

   a flat panel electronic detector of radiographic images, said detector having a known length; and
   a transport mechanism for mounting said detector for movement in a direction parallel to said known length so that said detector can be positioned in sequential contiguous positions to acquire a radiation image greater in length than said detector length.

2. The apparatus of claim 1 wherein said detector is mounted for movement by said transport mechanism in a vertical direction.

3. The apparatus of claim 1 including a radiation attenuating marking device located between said detector and the source of said radiographic image, said device being dimensioned to be equal or greater than the dimension of said elongated radiographic image.

4. The method of acquiring an elongated radiographic image comprising:

   positioning an elongated object between a source of x-rays and a flat panel electronic detector of radiographic images, said detector having a known length; and
   moving said detector in a direction parallel to said known length to position said detector in sequential contiguous positions to acquire a radiographic image of said elongated object

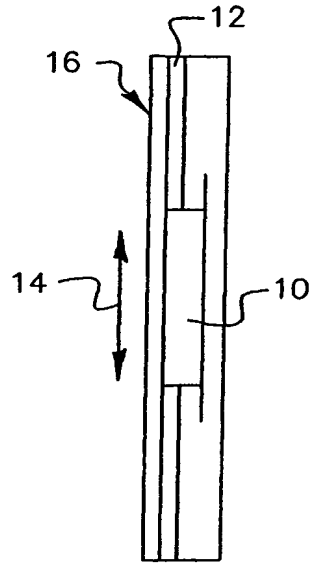

FIG. 1A

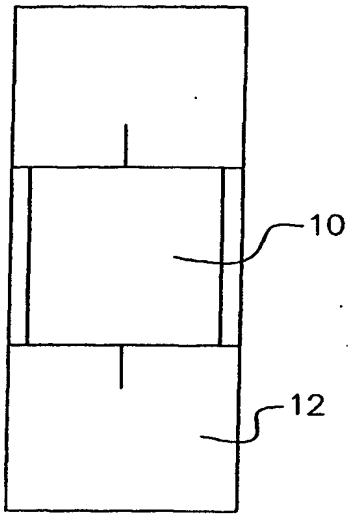

FIG. 1B

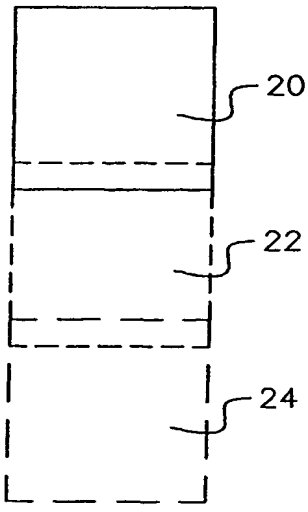

FIG. 2

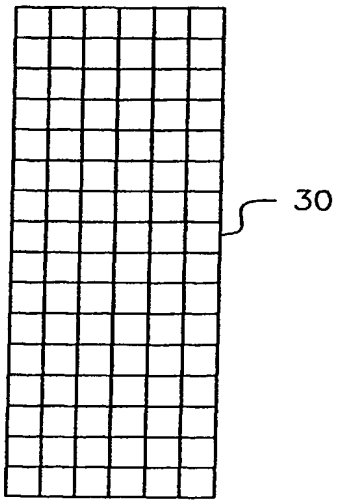

FIG. 3

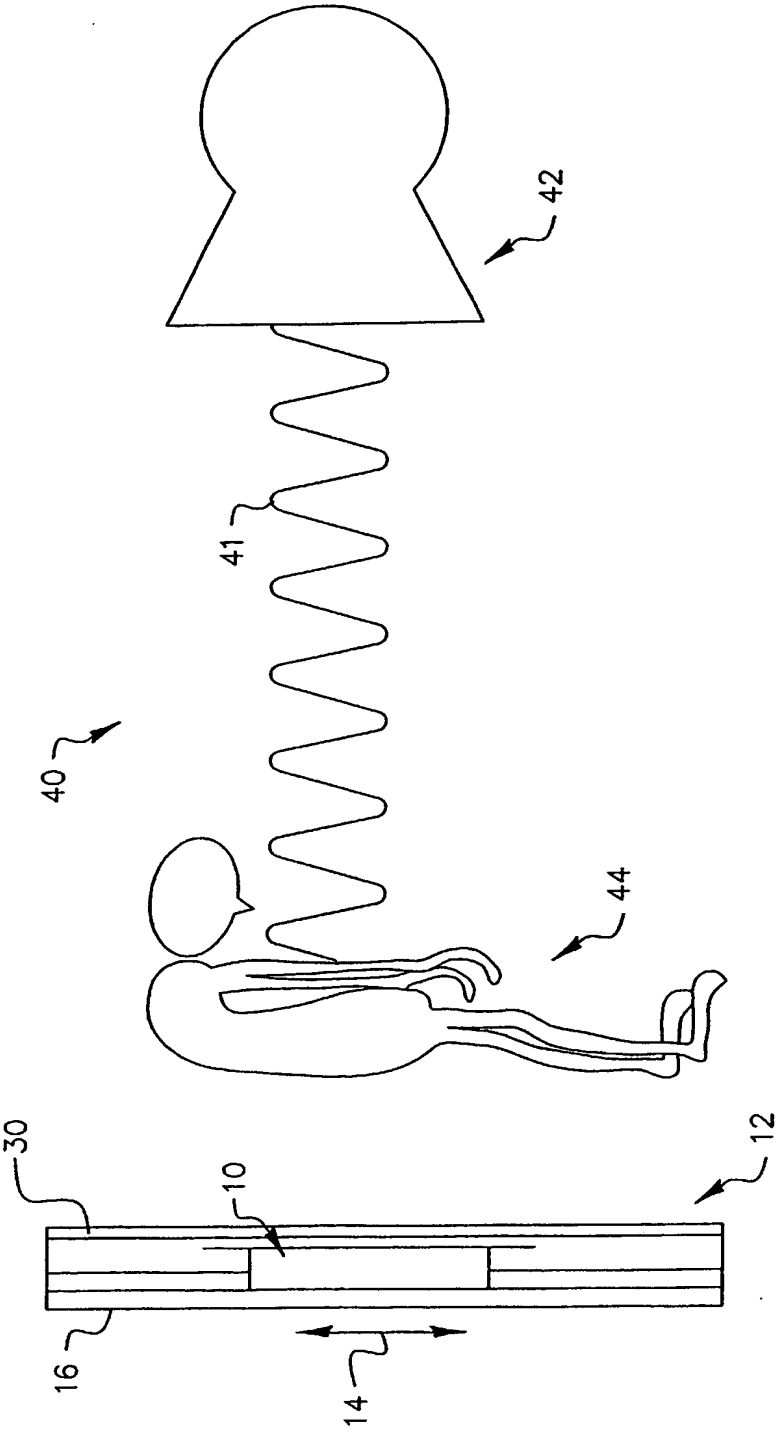

FIG. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 01 20 4826

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	WO 00 36820 A (NYHOLM KUSTAA ;PLANMED OY (FI)) 22 June 2000 (2000-06-22) * claim 1 *	1,4	H04N5/32
D,A	US 5 123 056 A (WILSON DAVID L) 16 June 1992 (1992-06-16) * column 3, line 58 - line 65 *	1,4	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

H04N
A61B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	12 February 2002	Bequet, T

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X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 01 20 4826

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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12-02-2002

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